



## A New Approach for Risk-based Characterisation of Polluted Soils

A recent study has analysed and interpreted the lead concentrations in urban upper soil in an industrialised city of England in terms of risk to human health. The authors mapped the probability of exceeding risk-based assessment criteria to analyse and interpret the collected surface soil lead concentrations. The study demonstrates that this approach has a valuable role to play in both land-use planning and environmental protection.

Urban soils are rather complex and heterogeneous mixtures of different materials and substances. In many cases, anthropogenic activities release contaminants into the urban soil, thus posing a potentially serious risk for the environment and human health. This is especially true in urban areas of Europe that have been or still are centres of industrial activity. Understanding the different processes that occur in urban soils and the distribution and fate of contaminants is of great importance. Previous studies have indicated that lead is one of the contaminants that pose the most significant hazard to human health in garden soils. The major sources of lead in urban environments are exhaust emissions from petrol vehicles, lead-based paints, use of arsenate pesticides, mining, or the application of sewage sludge to agricultural soils. Lead is a metabolic poison and therefore, soil lead is of particular concern with respect to the potential chronic risk to human health. Due to its low solubility and resistance to microbial degradation, it accumulates in the upper part of urban soils.

British researchers have recently analysed and interpreted the lead concentration in surface soil collected in an English city with an industrial heritage, in terms of human health risk. To this end, they have used a geostatistical approach, which allows us to:

- Predict a property where it has not been measured. In particular, the authors modelled the way lead concentration values were correlated in space, that is, its spatial distribution. This technique is known as variography.
- Quantify the uncertainty of the prediction.
- Predict the probability of exceeding a threshold concentration value.

Furthermore, they generated maps showing the probability of exceeding a defined health guideline value, using the technique of conditional simulation. This technique identifies areas of abnormally high lead concentration using the lead concentrations dataset and the spatial distribution previously estimated.

The current study demonstrates a surprising degree of spatial correlation of the urban soil lead concentrations. Since this is the basis for interpreting the results of the investigation on all sites, it is a particularly interesting finding. The authors used this spatial relation to produce a risk-based map to assist local authorities in their regulatory duties. The results also confirmed the usefulness of applying geostatistics to address spatial uncertainties.

According to the results of the study, conditional simulation is a more powerful technique than more commonly used techniques for interpreting site investigation findings such as kriging. Other techniques may significantly underestimate the risk posed by a site where only some of the measured soil concentrations exceed the guideline value. The authors argue that this is because other techniques undermine the original database.

The authors concluded that the techniques of variography and conditional simulation have a valuable role to play in both land use planning and environmental protection. Overall, the study provides new insights for the risk-based characterisation of pollutants in urban soils.

**Source:** P.J. Hooker and C.P. Nathanail (2006) « Risk-based characterisation of lead in urban soils », *Chemical Geology* 226:340-351.

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